

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
21 May 2004 (21.05.2004)

PCT

(10) International Publication Number
WO 2004/042432 A3

(51) International Patent Classification⁷: **H01L 31/04**,
31/042, 31/0352, 31/18

(21) International Application Number:
PCT/US2003/035147

(22) International Filing Date:
4 November 2003 (04.11.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10/290,119 5 November 2002 (05.11.2002) US

(71) Applicant: **NANOSOLAR, INC.** [US/US]; 2440 Embar-
cadero Way, Palo Alto, CA 94303 (US).

(72) Inventors: **SAGER, Brian**; 2250 Cornell Street, Palo
Alto, CA 94306 (US). **ROSCHISEN, Martin**; 611
Buena Vista Avenue West, San Francisco, CA 94117 (US).
PETRITSCH, Klaus; 837 Shell Boulevard, Foster City,

CA 94404 (US). **SMESTAD, Gregory**; P.O. Box 51038,
Pacific Grove, CA 93950 (US). **FIDANZA, Jacqueline**;
3661A 18th Street, San Francisco, CA 94110 (US).
MILLER, Gregory; 2275 Sharon Road, #204, Menlo
Park, CA 94025 (US). **YU, Dong**; 35238 Erving Court,
Fremont, CA 94536 (US).

(74) Agent: **ISENBERG, Joshua**; JDI PATENT, 204 Castro
Lane, Fremont, CA 94539 (US).

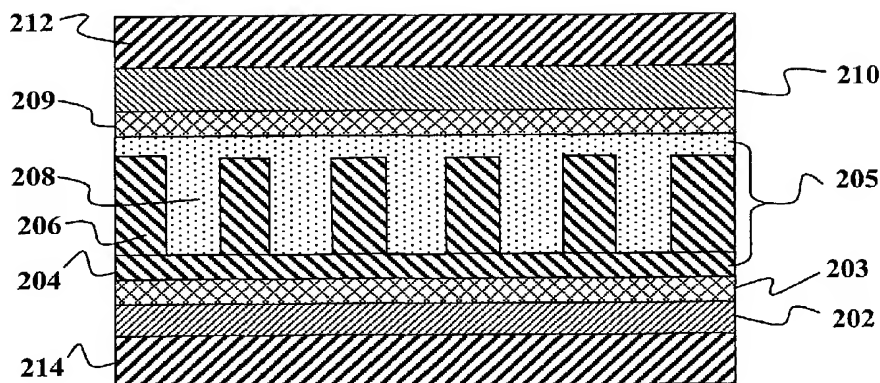
(81) Designated States (*national*): AE, AG, AL, AM, AT, AU,
AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU,
CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE,
GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR,
KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK,
MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT,
RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR,
TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (*regional*): ARIPO patent (GH, GM,
KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW),
Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),
European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE,
ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO,

[Continued on next page]

(54) Title: PHOTOVOLTAIC DEVICES FABRICATED BY GROWTH FROM POROUS TEMPLATE

200



(57) Abstract: Charge-splitting networks, optoelectronic devices, methods for making optoelectronic devices, power generation systems utilizing such devices and method for making charge-splitting networks are disclosed. An optoelectronic device (200) may include a porous nano-architected (e.g., surfactant-templated) film (206) having interconnected pores that are accessible from both underlying and overlying layers. A pore-filling material (208) substantially fills the pores. The interconnected pores have diameters of about 1-100 nm and are distributed in a substantially uniform fashion with neighboring pores separated by a distance of about 1-100 nm. The nano-architected porous film and the pore-filling material have complementary charge-transfer properties with respect to each other, i.e., one is an electron-acceptor and the other is a hole-acceptor. The nano-architected porous, film may be formed on a substrate by a surfactant templation technique such as evaporation-induced self-assembly.

WO 2004/042432 A3



SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Published:

- *with international search report*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

(88) Date of publication of the international search report:

23 December 2004

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US03/35147

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : H01L 31/04, 042, 31/0352, 31/18

US CL : 136/263, 265, 256; 257/40, 465, 466, 464, 461; 438/82, 71, 88, 57

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 136/263, 265, 256; 257/40, 465, 466, 464, 461; 438/82, 71, 88, 57

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- A	EP 1087446 A2 (DEN et al) 28 March 2001 (28.03.2001), Figures 4A, 4B, and 9A; and paragraphs 0031 and 0049.	1-15, 40, 41 ----- 16-39
X --- A	EP 1028475 A1 (LUPO et al) 16 August 2000 (16.08.2000), Figure 1; page 2, lines 46-58; and page 3, lines 49-55.	1-15, 40, 41 ----- 16-39
X,P --- A,P	US 2002/0192441 A1 (KALKAN et al) 19 December 2002 (19.12.2002), Figure 1; and paragraphs 0023 to 0040.	1-15, 40, 41 ----- 16-39
A	US 6,471,761 B2 (FAN et al) 29 October 2002 (29.10.2002).	1-41
A	DE 2741954 A1 (HERTEL) 29 March 1979 (29.03.1979).	1-41

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier application or patent published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

28 October 2004 (28.10.2004)

Date of mailing of the international search report

10 NOV 2004

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Facsimile No. (703) 305-3230

Authorized officer

Alan Diamond

Telephone No. 571-272-1700